Contents

Preface vii

1 Introduction 1

2 Software Conventions 5

2.1 Introduction 5
2.2 Register-Usage Conventions 5
2.3 Stack Usage Conventions 9
2.4 Procedure Format 12
2.5 Program Listings 13
2.5.1 Example 1: A Simple Leaf Function 13
2.5.2 Example 2: Leaf Function with Local Array 14
2.5.3 Example 3: Simple Nonleaf Function 14
2.5.4 Example 4: Nonleaf Function That Saves Three Registers 15
2.5.5 Example 5: Nonleaf Function That Uses Four Save Registers 16
2.5.6 Example 6: Simple Floating-Point Leaf Function 17

3 Initialization 19

3.1 Introduction 19
3.2 Example Programs 20
3.2.1 Example 1: A Simple Initialization 20
3.2.2 Example 2: Initialization That Flushes the Caches 23

3.3 Flushing the Cache 25
3.3.1 Flushing the R3000 Cache 26
3.3.2 Flushing the LR33000 Cache 31
3.4 Program Listings 33
3.4.1 Example 1: A Simple Initialization 33
3.4.2 Example 2: Initialization That Flushes the Cache 35
3.4.3 Example 3: R3000 Cache Flush 36
3.4.4 Example 4: R33000 Cache Flush 40

4 Exceptions **43**

4.1 Introduction 43
4.2 External Interrupts 45
4.2.1 Hardware Interrupt Examples 46
4.2.1.1 Example 1: A Single Interrupt Source 46
4.2.1.2 Example 2: Two Interrupt Sources 49
4.2.1.3 Example 3: Nested Interrupts 50
4.2.1.4 Example 4: Interrupt Handler in C 52
4.2.1.5 Example 5: UNIX Time Function Support 55
4.2.1.6 Example 6: Prioritizing Interrupts 57
4.2.2 Software Interrupts Example 64
4.3 Exceptions in a Branch Delay Slot 66
4.4 Interrupt Latency 74
4.5 Program Listings 76
4.5.1 Example 1: A Single Interrupt Source 76
4.5.2 Example 2: Two Interrupt Sources 79
4.5.3 Example 3: Nested Interrupts 85
4.5.4 Example 4: Interrupt Handler in C 91
4.5.5 Example 5: UNIX Time Function Support 98
4.5.6 Example 6: Prioritizing Interrupts 107
4.5.7 Example 7: Software Interrupts 118
4.5.8 Example 8: Exceptions in a Branch Delay Slot 122

5 Instruction Set Reference **139**

5.1 Introduction 139
5.2 Syntax Descriptions 140
5.3 Instruction Descriptions 148

A Overview of the MIPS1 Architecture **327**

A.1 Addressing 327
A.2 Modes of Operation 329
A.3 Coprocessor Units 330

A.4 Registers 332
A.5 Data Types 340
A.6 Instructions 340
A.6.1 Delay Instructions 341
A.6.2 Computational Instructions 342
A.6.3 Branches and Jumps 344
A.6.4 Loads and Stores 346
A.6.4.1 Big and Little Endian Byte Orderings 349
A.7 Program Listings 352

B Instruction Summary **355**

C Prologue and Epilogue Templates **369**

C.1 Program Listing 370

D Include Files **375**

D.1 machine.h 375
D.2 mips.h 381
D.3 lr33000.h 386

E Libraries **389**

E.1 stdio.c 389
E.2 put2681.c 393
E.3 r3kcflu.s 394
E.4 r33kcflu.s 398
E.5 putsable.c 400

F Vendors of MIPS Products **401**

Index **403**